

# OBSERVATIONS & RECOMMENDATIONS

After reviewing data collected from **STINSON LAKE, RUMNEY**, the program coordinators have made the following observations and recommendations.

Thank you for your continued hard work sampling the lake this year! Your monitoring group sampled the deep spot **three** times this year and has done so for many years! As you know, conducting multiple sampling events each year enables DES to more accurately detect water quality changes. Keep up the good work!

## FIGURE INTERPRETATION

- **Figure 1 and Table 1:** Figure 1 in Appendix A shows the historical and current year chlorophyll-a concentration in the water column. Table 1 in Appendix B lists the maximum, minimum, and mean concentration for each sampling year that the lake has been monitored through VLAP.

Chlorophyll-a, a pigment found in plants, is an indicator of the algal abundance. Because algae are usually microscopic plants that contain chlorophyll-a, and are naturally found in lake ecosystems, the chlorophyll-a concentration measured in the water gives an estimation of the algal concentration or lake productivity. **The median summer chlorophyll-a concentration for New Hampshire's lakes and ponds is 4.58 mg/m<sup>3</sup>.**

The current year data (the top graph) show that the chlorophyll-a concentration **decreased** from **July** to **September**.

The historical data (the bottom graph) show that the **2006** chlorophyll-a mean is ***much less than*** the state median and is ***slightly less than*** the similar lake median. For more information on the similar lake median, refer to Appendix F.

Overall, visual inspection of the historical data trend line (the bottom graph) shows a ***slightly increasing, meaning worsening***, in-lake chlorophyll-a trend since monitoring began in **1988**.

In the **2007** biennial annual report, since your lake will have been sampled for at least **ten** consecutive years for chlorophyll, we will conduct a statistical analysis of the historical data to objectively determine if there has been a significant change in the annual mean chlorophyll-a concentration since monitoring began. Please refer to Appendix E for a detailed statistical analysis explanation.

While algae are naturally present in all lakes, an excessive or increasing amount of any type is not welcomed. In freshwater lakes, phosphorus is the nutrient that algae typically depend upon for growth in New Hampshire lakes. Algal concentrations may increase as nonpoint sources of phosphorus from the watershed increase, or as in-lake phosphorus sources increase. Therefore, it is extremely important for volunteer monitors to continually educate all watershed residents about management practices that can be implemented to minimize phosphorus loading to surface waters.

- **Figures 2a and 2b and Tables 3a and 3b:** Figure 2a in Appendix A shows the historical and current year data for transparency without the use of a viewscope and Figure 2b shows the current year data for transparency with the use of a viewscope. Table 3a in Appendix B lists the maximum, minimum and mean transparency data without the use of a viewscope and Table 3b lists the maximum, minimum and mean transparency data with the use of a viewscope for each year that the lake has been monitored through VLAP.

Volunteer monitors use the Secchi disk, a 20 cm disk with alternating black and white quadrants, to measure how far a person can see into the water. Transparency, a measure of water clarity, can be affected by the amount of algae and sediment in the water, as well as the natural color of the water. **The median summer transparency for New Hampshire's lakes and ponds is 3.2 meters.**

The current year data (the top graph) show that the non-viewscope in-lake transparency **increased** from **July** to **August**, and then **decreased** from **August** to **September**.

The historical data (the bottom graph) show that the **2006** mean non-viewscope transparency is **greater than** the state median and is **slightly greater than** the similar lake median. Please refer to Appendix F for more information about the similar lake median.

The viewscope in-lake transparency was **greater than** the non-viewscope transparency on the **August** sampling event. The transparency was **not** measured with the viewscope on the **July** or **September** sampling events. As discussed previously, a comparison

of transparency readings taken with and without the use of a viewscope shows that the viewscope typically increases the depth to which the Secchi disk can be seen into the lake, particularly on sunny and windy days. We recommend that your group measure Secchi disk transparency with and without the viewscope on each sampling event.

It is important to note that viewscope transparency data are not compared to a New Hampshire median or similar lake median. This is because lake transparency has not been historically measured by DES with a viewscope. At some point in the future, the New Hampshire and similar lake medians for viewscope transparency will be calculated and added to the appropriate graphs.

Overall, visual inspection of the historical data trend line (the bottom graph) shows a **decreasing, meaning worsening**, trend for in-lake non-viewscope transparency since monitoring began in **1988**.

In the **2007** biennial annual report, since your lake will have been sampled for at least **ten** consecutive years for transparency, we will conduct a statistical analysis of the historical data to objectively determine if there has been a significant change in the annual mean chlorophyll-a concentration since monitoring began. Please refer to Appendix E for a detailed statistical analysis explanation.

Typically, high intensity rainfall causes sediment-laden stormwater runoff to flow into surface waters, thus increasing turbidity and decreasing clarity. Efforts should continually be made to stabilize stream banks, lake shorelines, disturbed soils within the watershed, and especially dirt roads located immediately adjacent to the edge of tributaries and the lake. Guides to best management practices that can be implemented to reduce, and possibly even eliminate, nonpoint source pollutants, are available from DES upon request.

- **Figure 3 and Table 8:** The graphs in Figure 3 in Appendix A show the amount of epilimnetic (upper layer) phosphorus and hypolimnetic (lower layer) phosphorus; the inset graphs show current year data. Table 8 in Appendix B lists the annual maximum, minimum, and median concentration for each deep spot layer and each tributary since the lake has been sampled through VLAP.

Phosphorus is typically the limiting nutrient for plant and algae growth in New Hampshire's lakes and ponds. Excessive phosphorus in a lake can lead to increased plant and algal growth over time. **The median summer total phosphorus concentration in the epilimnion (upper layer) of New Hampshire's lakes and ponds is**

**12 ug/L. The median summer phosphorus concentration in the hypolimnion (lower layer) is 14 ug/L.**

The current year data for the epilimnion (the top inset graph) show that the phosphorus concentration ***remained stable*** from **July** to **September**.

The historical data show that the **2006** mean epilimnetic phosphorus concentration is ***much less than*** the state median and is ***slightly less than*** the similar lake median. Refer to Appendix F for more information about the similar lake median.

The current year data for the hypolimnion (the bottom inset graph) show that the phosphorus concentration ***increased*** from **July** to **August**, and then ***decreased*** from **August** to **September**.

The historical data show that the **2006** mean hypolimnetic phosphorus concentration is ***much less than*** the state median and the similar lake median. Please refer to Appendix F for more information about the similar lake median.

Visual inspection of the historical data trend line for the epilimnion shows a ***variable, but overall slightly increasing, meaning slightly worsening***, phosphorus trend since monitoring began in **1988**.

Overall, visual inspection of the historical data trend line for the hypolimnion shows a ***variable*** phosphorus trend. Specifically, the mean annual concentration has ***fluctuated between approximately 4.5 and 14 ug/L*** since monitoring began in **1988**.

As discussed previously, in the **2007** biennial annual report, since your lake will have been sampled for phosphorus for at least **ten** consecutive years, we will conduct a statistical analysis of the historical data to objectively determine if there has been a significant change in the annual mean phosphorus concentration since monitoring began.

One of the most important approaches to reducing phosphorus loading to a waterbody is to continually educate watershed residents about the sources of phosphorus in a watershed and how excessive phosphorus loading can negatively affect the ecology and the recreational, economical, and ecological value of lakes and ponds.

## TABLE INTERPRETATION

### ➤ **Table 2: Phytoplankton**

Table 2 in Appendix B lists the current and historical phytoplankton species observed in the lake. Specifically, this table lists the three most dominant phytoplankton species observed in the sample and their relative abundance in the sample.

The dominant phytoplankton species observed in the **August** sample were ***Elakatothrix* (green)**, ***Chrysosphaerella* (golden-brown)**, and ***Dinobryon* (golden-brown)**.

Phytoplankton populations undergo a natural succession during the growing year. Please refer to the “Biological Monitoring Parameters” section of this report for a more detailed explanation regarding yearly plankton succession. Diatoms and golden-brown algae are typical in New Hampshire’s less productive lakes and ponds.

### ➤ **Table 4: pH**

Table 4 in Appendix B presents the in-lake and tributary current year and historical pH data.

pH is measured on a logarithmic scale of 0 (acidic) to 14 (basic). pH is important to the survival and reproduction of fish and other aquatic life. A pH below 6.0 typically limits the growth and reproduction of fish. A pH between 6.0 and 7.0 is ideal for fish. The median pH value for the epilimnion (upper layer) in New Hampshire’s lakes and ponds is **6.6**, which indicates that the surface waters in the state are slightly acidic. For a more detailed explanation regarding pH, please refer to the “Chemical Monitoring Parameters” section of this report.

The mean pH at the deep spot this year ranged from **5.88** in the hypolimnion to **6.48** in the epilimnion, which means that the water is **slightly acidic**.

It is important to point out that the pH in the hypolimnion (lower layer) was **lower (more acidic)** than in the epilimnion (upper layer). This increase in acidity near the lake bottom is likely due to the decomposition of organic matter and the release of acidic by-products into the water column.

Due to the presence of granite bedrock in the state and acid deposition received from snowmelt, rainfall, and atmospheric particulates, there is not much that can be feasibly done to effectively increase lake pH.

➤ **Table 5: Acid Neutralizing Capacity**

Table 5 in Appendix B presents the current year and historical epilimnetic ANC for each year the lake has been monitored through VLAP.

Buffering capacity (ANC) describes the ability of a solution to resist changes in pH by neutralizing the acidic input. The median ANC value for New Hampshire's lakes and ponds is **4.9 mg/L**, which indicates that many lakes and ponds in the state are at least "moderately vulnerable" to acidic inputs. For a more detailed explanation about ANC, please refer to the "Chemical Monitoring Parameters" section of this report.

The mean acid neutralizing capacity (ANC) of the epilimnion (upper layer) was **1.7 mg/L**, which is ***much less than*** the state median. In addition, this indicates that the lake is ***extremely vulnerable*** to acidic inputs.

➤ **Table 6: Conductivity**

Table 6 in Appendix B presents the current and historical conductivity values for tributaries and in-lake data. Conductivity is the numerical expression of the ability of water to carry an electric current, which is determined by the number of negatively charged ions from metals, salts, and minerals in the water column. The median conductivity value for New Hampshire's lakes and ponds is **40.0 uMhos/cm**. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

The mean annual epilimnetic conductivity at the deep spot this year was **20.07 uMhos/cm**, which is ***much less than*** the state median.

The conductivity in the lake is relatively ***stable*** and ***low***. Typically conductivity levels greater than 100 uMhos/cm indicate the influence of pollutant sources associated with human activities. These sources include septic system leachate, agricultural runoff, and road runoff which contains road salt during the spring snow-melt. We hope this trend continues!

➤ **Table 7a and Table 7b: Total Kjeldahl Nitrogen and Nitrite+Nitrate Nitrogen**

Table 7a in Appendix B presents the current year and historical Total Kjeldahl Nitrogen and Table 7b presents the current year and historical nitrite and nitrate nitrogen. Nitrogen is another nutrient that is essential for the growth of plants and algae. Nitrogen is

typically the limiting nutrient in estuaries and coastal ecosystems. However, in freshwater, nitrogen is not typically the limiting nutrient. Therefore, nitrogen is not typically sampled through VLAP. However, if phosphorus concentrations in freshwater are elevated, then nitrogen loading may stimulate additional plant and algal growth. Please refer to the “Chemical Monitoring Parameters” section of this report for a more detailed explanation.

During the most recent DES Lake Assessment Program survey, which was conducted during Summer **2002** the ratio of the total nitrogen concentration to total phosphorus (TN:TP) concentration in the epilimnion sample was **50**, which is **greater than 15**, indicating that the lake is **phosphorus-limited**. This means that any additional **phosphorus** loading to the pond will stimulate additional plant and algal growth. Therefore, it is not critical to conduct nitrogen sampling.

➤ **Table 8: Total Phosphorus**

Table 8 in Appendix B presents the current year and historical total phosphorus data for in-lake and tributary stations. Phosphorus is the nutrient that limits the algae’s ability to grow and reproduce. Please refer to the “Chemical Monitoring Parameters” section of this report for a more detailed explanation.

The phosphorus concentration in the **tributaries** was **relatively low** this year, which is good news. However, we recommend that your monitoring group sample the major tributaries to the lake during snow-melt and periodically during rainstorms to determine if the phosphorus concentration is **elevated** in the tributaries during these times. Typically, the majority of nutrient loading to a lake occurs in the spring during snow-melt and during intense rainstorms that cause soil erosion and surface runoff and within the watershed.

*For a detailed explanation on how to conduct rain event sampling and stream surveys, please refer to the 2002 VLAP Annual Report special topic article, which is posted on the VLAP website at [http://www.des.nh.gov/wmb/vlap/2002/documents/Appndxd\\_monit\\_oring.pdf](http://www.des.nh.gov/wmb/vlap/2002/documents/Appndxd_monit_oring.pdf), or contact the VLAP Coordinator.*

➤ **Table 9 and Table 10: Dissolved Oxygen and Temperature Data**

Table 9 in Appendix B shows the dissolved oxygen/temperature profile(s) collected during **2006**. Table 10 in Appendix B shows the historical and current year dissolved oxygen concentration in the hypolimnion (lower layer). The presence of dissolved oxygen is vital to fish and amphibians in the water column and also to bottom-dwelling organisms. Please refer to the “Chemical Monitoring Parameters”

section of this report for a more detailed explanation.

The dissolved oxygen concentration was greater than **100 percent** saturation at **7.0** meters at the deep spot on the **August** sampling event. Wave action from wind can also dissolve atmospheric oxygen into the upper layers of the water column. Layers of algae can also increase the dissolved oxygen in the water column, since oxygen is a by-product of photosynthesis. Considering that the depth to which sunlight could penetrate into the water column was approximately **7.0** meters on this sampling event, as shown by the Secchi disk transparency depth, and that the metalimnion, the layer of rapid decrease in water temperature and increase in water density where algae typically congregate, was located between approximately **7** and **10** meters, we suspect that an abundance of algae in the metalimnion caused the oxygen super-saturation.

The dissolved oxygen concentration was ***much lower in the bottom meter of the hypolimnion (lower layer) than in the epilimnion (upper layer)*** at the deep spot on the **August** sampling event. However, it is possible that the probe was in the sediment when the deepest reading was collected.

As stratified lakes age, and as the summer progresses, oxygen typically becomes ***depleted*** in the hypolimnion by the process of decomposition. Specifically, the reduction of hypolimnetic oxygen is primarily a result of biological organisms using oxygen to break down organic matter, both in the water column and particularly at the bottom of the lake where the water meets the sediment. When hypolimnetic oxygen concentration is depleted to less than 1 mg/L, the phosphorus that is normally bound up in the sediment may be re-released into the water column, a process referred to as ***internal phosphorus loading***.

➤ **Table 11: Turbidity**

Table 11 in Appendix B lists the current year and historical data for in-lake and tributary turbidity. Turbidity in the water is caused by suspended matter, such as clay, silt, and algae. Water clarity is strongly influenced by turbidity. Please refer to the “Other Monitoring Parameters” section of this report for a more detailed explanation.

The tributary and deep spot turbidity was ***relatively low*** this year, which is good news.

However, we recommend that your group sample the lake and surface water runoff areas during significant rain events to determine if stormwater runoff contributes turbidity and phosphorus to the lake.



*For a detailed explanation on how to conduct rain event sampling, please refer to the 2002 VLAP Annual Report special topic article, which is posted on the VLAP website at [http://www.des.nh.gov/wmb/vlap/2002/documents/Appndxd\\_monit\\_oring.pdf](http://www.des.nh.gov/wmb/vlap/2002/documents/Appndxd_monit_oring.pdf), or contact the VLAP Coordinator.*

➤ **Table 12: Bacteria (*E.coli*)**

Table 12 in Appendix B lists the current year and historical data for bacteria (*E.coli*) testing. *E. coli* is a normal bacterium found in the large intestine of humans and other warm-blooded animals. *E.coli* is used as an indicator organism because it is easily cultured and its presence in the water, in defined amounts, indicates that sewage **may** be present. If sewage is present in the water, potentially harmful disease-causing organisms **may** also be present.

The *E. coli* concentration in the **Brad Hall Below Leach** sample was **slightly elevated** on the **September** sampling event. However, the concentration of **80** counts per 100 mL **was not greater than** the state standard of 406 counts per 100 mL for recreational waters that are not designated public beaches.

If you are concerned about *E. coli* levels at this station, your monitoring group should conduct rain event sampling and bracket sampling in this area. This additional sampling may help us determine the source of the bacteria.

*For a detailed explanation on how to conduct rain event sampling and stream surveys, please refer to the 2002 VLAP Annual Report special topic article, which is posted on the VLAP website at [http://www.des.nh.gov/wmb/vlap/2002/documents/Appndxd\\_monit\\_oring.pdf](http://www.des.nh.gov/wmb/vlap/2002/documents/Appndxd_monit_oring.pdf), or contact the VLAP Coordinator.*

➤ **Table 13: Chloride**

Table 13 in Appendix B lists the current year and the historical data for chloride sampling. The chloride ion (Cl<sup>-</sup>) is found naturally in some surfacewaters and groundwaters and in high concentrations in seawater. Research has shown that elevated chloride levels can be toxic to freshwater aquatic life. In order to protect freshwater aquatic life in New Hampshire, the state has adopted **acute and chronic** chloride criteria of **860 and 230 mg/L** respectively. The chloride content in New Hampshire lakes is naturally low, generally less than 2 mg/L in surface waters located in remote areas away from habitation. Higher values are generally associated with salted highways and, to a lesser extent, with septic inputs. Please refer to

the “Chemical Monitoring Parameters” section of this report for a more detailed explanation.

Chloride sampling was **not** conducted during **2006**.

➤ **Table 14: Current Year Biological and Chemical Raw Data**

Table 14 in Appendix B lists the most current sampling year results. Since the maximum, minimum, and annual mean values for each parameter are not shown on this table, this table displays the current year “raw,” meaning unprocessed, data. The results are sorted by station, depth, and then parameter.

➤ **Table 15: Station Table**

As of the spring of 2004, all historical and current year VLAP data are included in the DES Environmental Monitoring Database (EMD). To facilitate the transfer of VLAP data into the EMD, a new station identification system had to be developed. While volunteer monitoring groups can still use the sampling station names that they have used in the past and are most familiar with, an EMD station name also exists for each VLAP sampling location. Table 15 in Appendix B identifies what EMD station name corresponds to the station names you have used in the past and will continue to use in the future.

### **DATA QUALITY ASSURANCE AND CONTROL**

#### **Annual Assessment Audit:**

During the annual visit to your lake, the biologist conducted a sampling procedures assessment audit for your monitoring group. Specifically, the biologist observed the performance of your monitoring group while sampling and filled-out an assessment audit sheet to document the ability of the volunteer monitors to follow the proper field sampling procedures, as outlined in the VLAP Monitor’s Field Manual. This assessment is used to identify any aspects of sample collection in which volunteer monitors failed to follow proper procedures, and also provides an opportunity for the biologist to retrain the volunteer monitors as necessary. This will ultimately ensure that the samples that the volunteer monitors collect are truly representative of actual lake and tributary conditions.

Overall, your monitoring group did an **excellent** job collecting samples on the annual biologist visit this year! Specifically, the members of your monitoring group followed the proper field sampling procedures and

there was no need for the biologist to provide additional training. Keep up the good work!

### **Sample Receipt Checklist:**

Each time your monitoring group dropped off samples at the laboratory this summer, the laboratory staff completed a sample receipt checklist to assess and document if your group followed proper sampling techniques when collecting the samples. The purpose of the sample receipt checklist is to minimize, and hopefully eliminate, future re-occurrences of improper sampling techniques.

Overall, the sample receipt checklist showed that your monitoring group did an **excellent** job when collecting samples and submitting them to the laboratory this year! Specifically, the members of your monitoring group followed the proper field sampling procedures and there was no need for the laboratory staff to contact your group with questions, and no samples were rejected for analysis.

### **USEFUL RESOURCES**

*Acid Deposition Impacting New Hampshire's Ecosystems*, DES fact sheet ARD-32, (603) 271-2975 or [www.des.nh.gov/factsheets/ard/ard-32.htm](http://www.des.nh.gov/factsheets/ard/ard-32.htm).

*Best Management Practices to Control Nonpoint Source Pollution: A Guide for Citizens and Town Officials*, DES Booklet WD-03-42, (603) 271-2975.

*Canada Geese Facts and Management Options*, DES fact sheet BB-53, (603) 271-2975 or [www.des.nh.gov/factsheets/bb/bb-53.htm](http://www.des.nh.gov/factsheets/bb/bb-53.htm).

*Cyanobacteria in New Hampshire Waters Potential Dangers of Blue-Green Algae Blooms*, DES fact sheet WMB-10, (603) 271-2975 or [www.des.nh.gov/factsheets/wmb/wmb-10.htm](http://www.des.nh.gov/factsheets/wmb/wmb-10.htm).

*Erosion Control for Construction in the Protected Shoreland Buffer Zone*, DES fact sheet WD-SP-1, (603) 271-2975 or [www.des.nh.gov/factsheets/sp/sp-1.htm](http://www.des.nh.gov/factsheets/sp/sp-1.htm).

*Impacts of Development Upon Stormwater Runoff*, DES fact sheet WD-WQE-7, (603) 271-2975 or [www.des.nh.gov/factsheets/wqe/wqe-7.htm](http://www.des.nh.gov/factsheets/wqe/wqe-7.htm).

*Lake Protection Tips: Some Do's and Don'ts for Maintaining Healthy Lakes*, DES fact sheet WD-BB-9, (603) 271-2975 or [www.des.nh.gov/factsheets/bb/bb-9.htm](http://www.des.nh.gov/factsheets/bb/bb-9.htm).

*Low Impact Development Hydrologic Analysis*. Manual prepared by Prince George's County, Maryland, Department of Environmental Resources. July 1999. To access this document, visit [www.epa.gov/owow/nps/lid\\_hydr.pdf](http://www.epa.gov/owow/nps/lid_hydr.pdf) or call the EPA Water Resource Center at (202) 566-1736.

*Low Impact Development: Taking Steps to Protect New Hampshire's Surface Waters*, DES fact sheet WD-WMB-16, (603) 271-2975 or [www.des.nh.gov/factsheets/wmb/wmb-17.htm](http://www.des.nh.gov/factsheets/wmb/wmb-17.htm).

*Proper Lawn Care In the Protected Shoreland, The Comprehensive Shoreland Protection Act*, DES fact sheet WD-SP-2, (603) 271-2975 or [www.des.nh.gov/factsheets/sp/sp-2.htm](http://www.des.nh.gov/factsheets/sp/sp-2.htm).

*Road Salt and Water Quality*, DES fact sheet WD-WMB-4, (603) 271-2975 or [www.des.nh.gov/factsheets/wmb/wmb-4.htm](http://www.des.nh.gov/factsheets/wmb/wmb-4.htm).

*Sand Dumping - Beach Construction*, DES fact sheet WD-BB-15, (603) 271-2975 or [www.des.nh.gov/factsheets/bb/bb-15.htm](http://www.des.nh.gov/factsheets/bb/bb-15.htm).

*Shorelands Under the Jurisdiction of the Comprehensive Shoreland Protection Act*, DES fact sheet SP-4, (603) 271-2975 or [www.des.nh.gov/factsheets/sp/sp-4.htm](http://www.des.nh.gov/factsheets/sp/sp-4.htm).

*Soil Erosion and Sediment Control on Construction Sites*, DES fact sheet WQE-6, (603) 271-2975 or [www.des.nh.gov/factsheets/wqe/wqe-6.htm](http://www.des.nh.gov/factsheets/wqe/wqe-6.htm).

*Swimmers Itch*, DES fact sheet WD-BB-2, (603) 271-2975 or [www.des.nh.gov/factsheets/bb/bb-2.htm](http://www.des.nh.gov/factsheets/bb/bb-2.htm).

*Through the Looking Glass: A Field Guide to Aquatic Plants*, North American Lake Management Society, 1988, (608) 233-2836 or [www.nalms.org](http://www.nalms.org).

*Weed Watchers: An Association to Halt the Spread of Exotic Aquatic Plants*, DES fact sheet WD-BB-4, (603) 271-2975 or [www.des.nh.gov/factsheets/bb/bb-4.htm](http://www.des.nh.gov/factsheets/bb/bb-4.htm).

*Watershed Districts and Ordinances*, DES fact sheet WD-WMB-16, (603) 271-2975 or [www.des.nh.gov/factsheets/wmb/wmb-16.htm](http://www.des.nh.gov/factsheets/wmb/wmb-16.htm).